Draft Internal Assessment Resource
For planning purposes only

Draft standard 2.2: Demonstrate understanding of physics relevant to a selected context

Resource reference: Physics 2.2A

Resource title: DIY Adjustable Glasses

Credits: 3

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Teacher guidelines

The following guidelines are designed to ensure that teachers can carry out valid and consistent assessment using this internal assessment resource.

Teachers need to be very familiar with the outcome being assessed by Achievement Standard Physics 2.2. The achievement criteria and the explanatory notes contain information, definitions, and requirements that are crucial when interpreting the standard and assessing students against it.

Context/setting

This assessment is a directed research assignment – students perform research and prepare a report describing the physics of adjustable fluid-filled glasses.

Conditions

Research and report writing should be performed individually, outside of class time (approximately 4 hours of effort).

Confirm the format of the report with students. The format could be, but is not limited to:

- written report (including illustrations, diagrams and graphs, if appropriate)
- poster presentation (including annotations or supporting notes)
- oral presentation (with written references)
- project booklet
- multi-media (for example, a recorded video presentation or web page with embedded video, graphics, and text)
- computer presentation software file.

All sources of information, images, diagrams (not generated by the student) and data must be acknowledged. All sources of information must be recorded in a traceable format which means that someone else could go straight to where the information came from.

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Resource requirements

Ensure students have access to a range of information sources, for example, physics textbooks and the following websites:

- www.howstuffworks.com
- http://www.ted.com/talks/josh_silver_demos_adjustable_liquid_filled_eyeglasses.html
- http://www.vdw.ox.ac.uk/.

Additional information

None.

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Achievement	Achievement with Merit	Achievement with Excellence
Demonstrate understanding of physics relevant to a selected context.	Demonstrate in-depth understanding of physics relevant to a selected context.	Demonstrate comprehensive understanding of physics relevant to a selected context.

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Student instructions

Introduction

John Silver, a retired physics professor, has a plan for bringing clear vision to a billion poor people: $1 eyeglasses with easily adjustable, fluid-filled lenses.

According to the World Health Organisation, "there are about one billion people who would benefit from vision correction". For many of these people, affordable glasses are unobtainable. For example, in parts of Africa, people live on less than $1 a day and there is only one optometrist per one million people.

John Silver invented fluid-filled lenses over 20 years ago. The fluid-filled lens is a chamber with a plastic flexible membrane on both sides. The chamber forms a clear sac that can be filled with silicone oil. The first time you put on the glasses, you use an attached syringe to adjust the amount of fluid in the sac. When your vision is clear, you seal the chamber, remove the syringe, and wear just like normal glasses.

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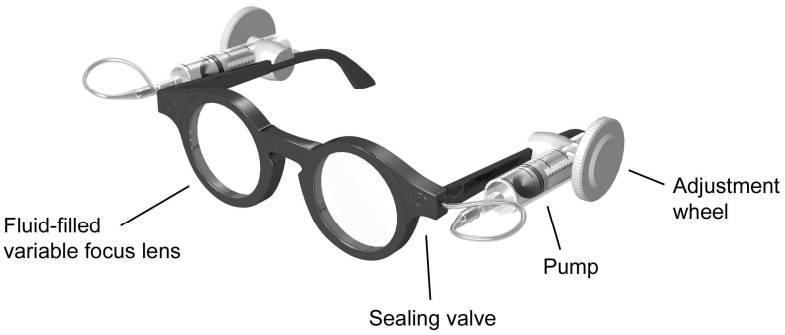
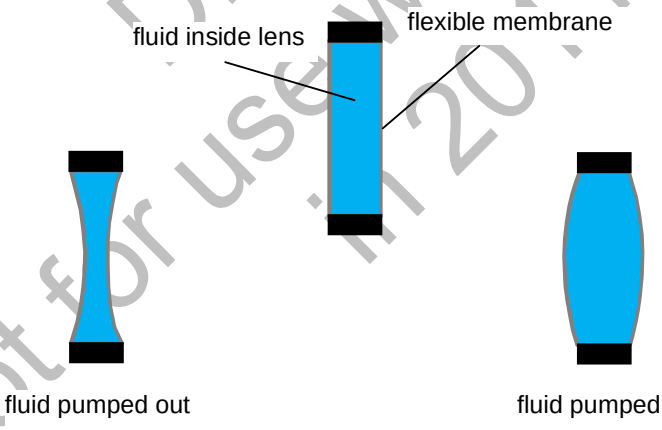


The refractive index of silicone oil is 1.406. To adjust the lens, you turn a knob which either pumps fluid into the chamber or pumps fluid out of it.



Over 30,000 pairs have been distributed in 15 countries. Today, John continues to work on improving the technology and bring costs down.

In this assessment, you will research the physics of fluid-filled lenses, and prepare a report that explains the relevant physics principles.

Images throughout this task supplied with permission by the Centre for Vision in the Developing World (http://www.vdw.ox.ac.uk/).

Information about fluid-filled lenses abridged and amended from *http://blogs.discovermagazine.com/discoblog/2009/01/05/cheap-liquid-glasses-bring-clear-vision-to-the-poor/*.

Task

Working independently, perform research to gather information on the physics of fluid-filled lenses. Process this information and produce a report that uses the relevant physics principles to explain how adjustable fluid-filled lenses work. Confirm the format of the report with your teacher, for example, a written report, a poster or computer presentation. Submit your report by <insert date>.

Your report could include the following:

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- the physics theory of lenses
- how lenses are able to correct short-sightedness, long-sightedness and loss of accommodation
- why it is necessary to be able to pump the fluid in and out of the lenses
- a rationale, in terms of physics theory, for the choices that were made in the design of / materials used in the glasses.

Put all material copied from other sources in quotation marks.

Your report will be assessed on how well you integrate or link descriptions of the related physics to the context of fluid-filled lenses, for example, by justifying, elaborating, or analysing how or why the described physics is relevant to this context.

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Assessment schedule: Physics 2.2A DIY Adjustable Glasses

Evidence/Judgements for Achievement	Evidence/Judgements for Achievement with Merit	Evidence/Judgements for Achievement with Excellence
Student correctly: • identifies and describes the characteristics of the physics related to the given context • describes how and/or why the physics applies to this context. For example, a student who *achieved* should provide the following information: • *light refracts towards the normal as light enters a denser medium* • *light refracts away from the normal as light leaves a denser medium* • *the shape of convex lens causes light to converge* • *the shape of concave lens causes light to diverge* • *how an external lens in front of the eye can correct long sight and short sight.* • *how the thickness / shape of the corrective lens relates to the severity of the long / short sightedness.*	Student correctly: • identifies and describes in depth the characteristics of the physics related to the given context • provides reasons how and/or why the physics applies to this context. or example, a *merit* student should provide the following information: • *refraction is dependent on the refractive index of the lens* • *different liquids have different refractive indexes, therefore different liquids have a different effect on the power of a (same shaped) fluid filled lens* • *silicone oil is more suitable than water because it has a greater refractive index and so refracts light more for the same quantity of fluid* • *in fluid filled convex lenses, if more liquid in pumped into the lens, the convex lens changes shape in such a way that light converges more* • *in fluid filled concave lenses, if more liquid in removed from the lens, the concave lens changes shape in such a way that light diverges more* • *how increased convergence or divergence of light improves specific vision problems.*	Student correctly: • comprehensively identifies and describes the characteristics of the physics related to the given context • elaborates how and/or why the physics applies to this context • justifies why the particular physics is well-suited to this context, and/or compares alternatives For example, an *excellence* student should provide the following information: • *refraction and therefore lens power is a function of the refractive index of the lens material* • *silicone oil has a greater refractive index than water, but smaller refractive index than glass or plastic – lenses made of silicone oil must be thicker than glasses made of glass or plastic and are therefore "clunky" compared to them* • *a detailed explanation of how concave lenses reduce short-sightedness including details of what short-sightedness is, what a short-sightedness person would see without the aid of glasses, and how the glasses help a short-sightedness person* • *a detailed explanation of how convex lenses reduce long-sightedness and loss of accommodation including details of what long-sightedness/loss of accommodation is, what a long-sightedness/loss of accommodation person would see without the aid of glasses, and how the glasses help a long-sightedness/loss of accommodation person.*

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Final grades will be decided using professional judgement based on a holistic examination of the evidence provided against the criteria in the Achievement Standard.

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